EXHIBIT 16

FIFTH FIVE-YEAR REVIEW REPORT
HYDE PARK LANDFILL SUPERFUND SITE
NIAGARA COUNTY
NIAGARA FALLS, NEW YORK

Prepared by

U.S. Environmental Protection Agency
Region 2
New York, New York

August 2016

Approved by:

Walter E. Mugdan, Director
Emergency and Remedial Response Division

Date: August 23, 2016

393255

Table of Contents

Executive Summary ..... **iii**
Five-Year Review Summary Form ..... **iv**
Introduction **1**
Site Chronology **1**
Background **1**
Remedial Actions **3**
Progress Since Last Review **12**
Five-Year Review Process **12**
Administrative Components *12*
Community Involvement *12*
Document Review *12*
Data Review *13*
Site Inspection *16*
Interviews *16*
Institutional Controls Verification *16*
Technical Assessment **17**
Question A: Is the remedy functioning as intended by the decision documents? *17*
Question B: Are the exposure assumptions, toxicity data, cleanup levels, and remedial action objectives used at the time of the remedy still valid? *19*
Question C: Has any other information come to light that could call into question the protectiveness of the remedy? *23*
Technical Assessment Summary *23*
Issues, Recommendations and Follow-Up Actions **23**
Protectiveness Statement **23**
Next Review **24**
Figures **25**
Tables **28**

Executive Summary

This is the fifth five-year review for the Hyde Park Landfill Superfund site located in Niagara Falls, Niagara County, New York. The purpose of this five-year review is to review information to determine if the remedy is and will continue to be protective of human health and the environment. The triggering action for this statutory five-year review is the completion date of the previous five-year review, September 27, 2011.

The remedy at the Hyde Park Landfill Superfund site protects human health and the environment. There are no exposure pathways that could result in unacceptable risks, and none are expected as long as the engineered controls currently in place continue to be properly operated, monitored, and maintained.

Five-Year Review Summary Form

SITE IDENTIFICATION		
Site Name: Hooker Hyde Park Landfill Superfund site		
EPA ID: NYD000831644		
Region: 2	**State:** NY	**City/County:** Niagara Falls/Niagara

SITE STATUS	
NPL Status: Deleted	
Multiple OUs? No	**Has the site achieved construction completion?** Yes

REVIEW STATUS
Lead agency: EPA ***[If "Other Federal Agency", enter Agency name]*:**
Author name (Federal or State Project Manager): Gloria M. Sosa
Author affiliation: EPA
Review period: 9/27/2011 - 6/30/2016
Date of site inspection: 5/2/2016
Type of review: Statutory
Review number: 5
Triggering action date: 9/27/2011
Due date *(five years after triggering action date)*: 9/27/2016

Issues/Recommendations
OU(s) without Issues/Recommendations Identified in the Five-Year Review:
OU1

Protectiveness Statement(s)		
Operable Unit: 01	*Protectiveness Determination:* Protective	*Addendum Due Date (if applicable):*
Protectiveness Statement: The remedy at the Hyde Park Landfill Superfund site is protective of human health and the environment.		

Sitewide Protectiveness Statement	
Protectiveness Determination: Protective	*Addendum Due Date (if applicable):*
Protectiveness Statement: The remedy at the Hyde Park Landfill Superfund site is protective of human health and the environment.	

Introduction

The purpose of a five-year review is to evaluate the implementation and performance of a remedy in order to determine if the remedy is and will continue to be protective of human health and the environment and is functioning as intended by the decision documents. The methods, findings, and conclusions of reviews are documented in the five-year review. In addition, five-year review reports identify issues found during the review, if any, and document recommendations to address them.

This is the fifth five-year review for the Hyde Park Landfill Superfund site, located in Niagara Falls, Niagara County, New York. This five-year review was conducted by the Environmental Protection Agency (EPA) Remedial Project Manager (RPM) Gloria M. Sosa. The review was conducted pursuant to Section 121(c) of the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA), as amended, 42 U.S.C. §9601 *et seq.* and 40 CFR 300.430(f)(4)(ii), and in accordance with the *Comprehensive Five-Year Review Guidance*, OSWER Directive 9355.7-03B-P (June 2001). This report will become part of the site file.

The triggering action for this statutory review is the previous five-year review, dated September 27, 2011. A five-year review is required at this site due to the fact that hazardous substances, pollutants or contaminants remain at the site above levels that allow for unlimited use and unrestricted exposure and use of the site. The site consists of one operable unit, which is addressed in this five-year review.

Site Chronology

See Table 1 for the site chronology.

Background

Physical Characteristics

The Hyde Park Landfill is a fifteen-acre site in the northwest corner of the Town of Niagara, New York. The geology underlying the site is glacial overburden overlying Lockport Dolomite, a fractured bedrock. Groundwater in the vicinity of the landfill flows in both the overburden and the bedrock. Generally, the overburden is saturated at depths below ten feet. The groundwater movement from the landfill is both downward and horizontal. At one time some of this groundwater exited the Niagara Gorge Face in the form of seeps which flowed into the Niagara River. Contaminants migrate from the landfill in two forms: aqueous phase liquid (APL or contaminated groundwater) and dense non-aqueous phase liquid (NAPL). The fractured bedrock environment typical of the Niagara Falls area makes it difficult to locate and remove NAPL.

The Hyde Park APL plume is composed primarily of benzoic acids, chlorobenzoic acids, chlorendic acid and phenol. Total organic halogens, phenols and other compounds have been detected in the APL Plume in the bedrock seeps at the Niagara Gorge Face in the parts per million

(ppm) range. 2,3,7,8-tetrachlorodibenzo-*p*-dioxin (TCDD) has been detected in the Gorge Face seeps at 0.18 parts per trillion (ppt).

The major known constituents of the Hyde Park NAPL are dichlorotoluene, chlorotoluene, toluene, tetrachloroethylene, phenol, methyl benzoate, benzoic acid and benzochlorotrifluorides. Twenty ppm of TCDD and substantial amounts of polychlorinated biphenyls (PCBs) based on Aroclor analysis have been detected in the NAPL. Forty to fifty percent of the constituents of NAPL are high molecular weight compounds which have not been identified by gas chromatograph mass spectrometry analysis. Hyde Park NAPL is denser than water, weighing approximately 80 pounds per cubic foot, compared to water which weighs 62.4 pounds per cubic foot. TCDD has been detected in the bedrock water within the NAPL plume at concentrations between 0.44 and 0.9 ppt.

There were two onsite lagoons and four rail tank cars in which NAPL was stored.

The Bloody Run is a small drainage area flowing north from the landfill and considered part of the site. The stream flows under a neighboring industry via a storm sewer, and under University Drive via a storm sewer which emerges at the Niagara Gorge.

Land and Resource Use

The site is immediately surrounded by several industrial facilities and property owned by the New York Power Authority. Residential neighborhoods are located to the northwest and south of the landfill. The Niagara River, an international boundary, is located 2,000 feet to the northwest, down the Niagara Gorge which descends approximately 350 feet below the surface of the landfill. The Niagara River flows into Lake Ontario approximately 10 miles downstream of the site. Lake Ontario is a drinking-water source for millions. Niagara University, which has three thousand students, is less than one mile in distance from the site.

History of Contamination

Hooker Chemical and Plastic Corporation, now Occidental Chemical Corporation (OCC), disposed of approximately 80,000 tons of waste (drummed and bulk liquids, and solids) at the site, from 1953 to 1975, consisting primarily of chlorobenzenes, chlorotoluenes, halogenated aliphatics and 2,4,5-trichlorophenol (TCP) from still bottoms. An estimated 3,300 tons of TCP were disposed of at the site; TCP wastes are known to contain significant amounts of TCDD. EPA has estimated that approximately 0.7 - 1.6 tons of TCDD were associated with the TCP wastes at the site.

Basis for Taking Action

EPA filed a lawsuit in 1979 in federal district court under the authority of the Resource Conservation and Recovery Act and the Clean Water Act seeking to require that OCC remediate the site. EPA, New York State and OCC filed a *Stipulation and Judgment Approving Settlement Agreement* (Settlement Agreement) in January 1981, which the Court approved in April 1982. The Settlement Agreement required OCC to perform an Aquifer Survey (which can be compared to a remedial investigation study) to define the extent of contamination in the overburden and bedrock and assess remedial alternatives. OCC completed this effort in 1983. The results of the aquifer survey were used by the negotiation team (EPA/New York State and OCC) to agree on remedial

actions to be performed at the site. These required remedial actions were documented in a *Stipulation on Requisite Remedial Technology* (RRT Stipulation), which was approved by the Court in August 1986. EPA issued an Enforcement Decision Document (EDD - a precursor to a Record of Decision) on November 26, 1985, which documented the remedial action selected for site cleanup. The site was listed on the National Priorities List in 1982.

EPA acknowledged that the APL and NAPL plumes would not be remediated to drinking-water standards because of the persistent nature of NAPL. Therefore, the goal of the remedies selected in the EDD is to hydraulically contain contaminated groundwater (APL plume) in the vicinity of the site, while extracting as much NAPL as is practicable. The achievement of hydraulic containment of APL would be proved by the creation of an inward hydraulic gradient surrounding the landfill (*i.e.*, groundwater in the vicinity of the site would flow radially inward towards the landfill). The reduction of NAPL volume would create less driving force (head) on the NAPL plume, preventing further NAPL migration. The RRT stipulated that the extracted NAPL would be destroyed by incineration.

The RRT established the basis for a groundwater monitoring program to provide data for assessing any potential adverse impacts from the site to the surrounding community. A series of monitoring programs were also established to determine if contaminants from the site had migrated beyond the shale, which was believed to be an aquitard that would prevent contamination from further downward migration.

Under the agreement, OCC was required to cap the landfill and its perimeter to prevent further infiltration of rain water, which produces leachate. Remedial actions, such as the sealing of sumps and manholes and the capping of pipes, would be performed by OCC at neighboring industries. Sediments in the Bloody Run would be excavated or capped. Remedial action would be conducted at the Niagara River Gorge Face.

During the RRT negotiations, EPA performed a risk assessment using worst case exposure scenarios, which was the approach used before the 1989 Risk Assessment Guidance for Superfund, Part A was issued and applied at sites. The risk assessment for the APL plume flux indicated that the greatest risk from the site was the consumption of fish contaminated with TCDD. Therefore, the RRT required that a study be performed by EPA, New York State and OCC to determine if TCDD was bioaccumulating in fish consumed by anglers in Lake Ontario.

Remedial Actions

Remedy Selection

The Hyde Park Landfill remedy selected in the 1985 EDD includes the following specific elements:

- Source control (prototype extraction wells);
- Containment and collection of APL and NAPL in the overburden;
- Containment and collection of APL and NAPL in the bedrock;
- Treatment of collected APL and NAPL;

- Community Monitoring Program (monitoring wells for early detection of site chemicals);
- Intermediate and Deep Formations Study (monitoring wells);
- Industrial Protection Program (remediation of sumps and sealing of manholes);
- Perimeter Capping (clay cap around perimeter of landfill);
- Gorge face seeps remediation;
- Bloody Run Excavation or Capping;
- Final capping and site closure; and,
- TCDD Bioaccumulation Study in Lake Ontario.

The EDD did not identify remedial action objectives. However, during the remedial investigation, EPA acknowledged that the APL and NAPL plumes would not be remediated to drinking water standards because of the persistent nature of NAPL. Therefore, the goal of the remedies selected in the EDD is to hydraulically contain contaminated groundwater (APL plume) in the vicinity of the site, while extracting as much NAPL as is practicable.

The RRT established APL Plume Flux Action Levels for the following chemicals: TCDD (0.5 grams/year); perchloropentacyclodecane [Mirex] (0.005 lbs/day); Aroclor 1248 (0.005 lbs/day); and, chloroform (1.7 lbs/day). These action levels represent concentrations of these contaminants that, if detected entering the river (flux of contaminants to the river) at or above these concentrations, would cause OCC to take additional remedial actions (e.g. increased pumping, installing additional wells or other remedial measures) to reduce these contaminant levels.

Remedy Implementation

Source Control

The purpose of the source control program is to reduce the amount of chemicals migrating downward from the landfill by removing any mobile NAPL remaining in the landfill. The source control remedial program, as described in the RRT Stipulation, consists of a prototype system of up to six 36-inch diameter wells installed in the overburden inside the landfill. These wells were designed to collect NAPL for subsequent destruction by incineration.

As required by the RRT, OCC installed two 36-inch extraction wells in the landfill in 1990. OCC performed pump tests on these wells and also investigated potential NAPL source areas within the landfill through 1993. However, the large-diameter source-control wells did not collect as much NAPL as was expected. The source control system was redesigned using the 2-inch NAPL extraction well design OCC had successfully utilized at its Durez facility. OCC installed four 2-inch source control wells in the landfill with two-phase flow pumps to facilitate the pumping of NAPL. Nine monitoring wells were also installed in the landfill. One source-control well has since been converted to a monitoring well because of low NAPL collection.

Although the source control program has not recently yielded large quantities of NAPL as originally anticipated, more than 300,000 gallons of NAPL have been collected and treated to date. EPA believes that most of NAPL which was once present in the overburden in the landfill has either flowed into the bedrock, been captured, or remains in pockets or pools that are not hydraulically connected to the source control wells. In addition, the installation of the final cap on

the landfill has eliminated the continued production of leachate from rainfall and thereby dramatically reduced the hydraulic head of APL within the landfill, removing the driving force for the NAPL.

NAPL is extracted by the source-control wells and flows into a decanter at the onsite Storage and Treatment Facility. The total recovered NAPL volume is measured monthly and the potential amount of NAPL contributed by each well is estimated annually by OCC. The source-control wells are currently pumped only once per month because of low NAPL volume.

Overburden - APL and NAPL Plume Containment System

The goal of the remedy selected for the overburden is to contain the lateral migration of the NAPL plume and contain the APL plume, to the extent practicable, as stated in the RRT Stipulation. The remedy was implemented by construction of the Overburden Barrier Collection System (OBCS), a drain around the entire landfill to contain and collect contaminated groundwater. The OBCS was installed in 1991. Eight monitoring well pairs were installed beyond the alignment of an existing drain around the landfill. One well from each pair is inside the APL plume limits and one well from each pair is outside the APL plume. The inner wells are pumped to create an inward hydraulic gradient. Hydraulic stabilization was deemed to have occurred in 1994, following one year of continuous dewatering of the OBCS (*i.e.*, no accumulation of water in the wet wells was found).

Hydraulic monitoring of the OBCS is performed by water-level measurements taken at the eight well pairs. Water-level measurements indicate whether an inward gradient is being achieved, thereby capturing the contaminated groundwater associated with the site.

Bedrock NAPL Plume Containment System

OCC performed an investigation which defined the extent of the NAPL plume in the bedrock surrounding the landfill in 1982 and revised the extent of the NAPL plume again in 1996 after performing further investigation. OCC performs NAPL presence checks at all 49 bedrock wells and these checks indicate that the NAPL plume has not significantly migrated since 1996.

The NAPL Plume Containment System was designed to create an inward hydraulic gradient in the bedrock aquifer surrounding the landfill in order to capture groundwater contaminated by site chemicals. The system was designed and installed in a phased approach in order to achieve proper placement of the extraction wells.

Phase I, consisting of six purge wells, was installed by OCC in 1990, and the installation of the Phase II wells was completed in 1993. OCC conducted pump tests on the Phase II wells which were completed in 1994. Additional wells were installed and a network of eleven bedrock purge wells was operational in 1997.

The RRT Stipulation established a monitoring program with well location selected along vectors radiating from the center of the landfill. As required, the purge wells are on the inside of the NAPL plume with monitoring wells outside the NAPL plume. The RRT required an inward gradient across the NAPL plume boundary. Implementation of the vector scheme was not as effective a

monitoring system as originally designed. To enhance the vector monitoring scheme, with which OCC reports its site cleanup progress, local groundwater contour maps were developed.

In 2000, as discussed below, OCC began a re-characterization of the site. The conceptual model of three groundwater zones in the bedrock was replaced with eleven distinct flow zones. OCC retrofitted existing wells to monitor the groundwater in these 11 zones. After collecting water levels over a two year period, OCC concluded that the Bedrock NAPL Plume Containment System satisfies the performance objectives of the RRT and that the containment objective is maintained year-round.

Bedrock APL Plume Containment System

The APL Plume Containment System, consisting of three purge wells installed at the Niagara Gorge Face, was designed to collect a significant portion (60-88%) of the contaminated groundwater outside the NAPL plume (as required by the RRT Stipulation). These wells were installed in 1994. The portion of the APL plume not collected is monitored by three flux monitoring well clusters to the west of the site and three piezometer clusters in the northern and eastern portion of the APL plume.

None of the APL plume flux parameters was detected above their respective reporting levels in groundwater samples collected in annual monitoring performed in November 2010. As a result, OCC was not required to perform calculation of the flux to the Niagara River Gorge.

Leachate Storage and Treatment Facility

Since April 1990, APL is treated onsite at the Leachate Storage and Treatment Facility with a capacity of 400 gallons per minute. The APL/NAPL mixture is pumped from the wells through force mains into a decant tank. The NAPL, denser than water, settles to the bottom. APL is taken off the top of the decanter and pumped into the storage tanks. The APL first passes through sacrificial activated carbon beds (which cannot be recycled because of the dioxin and are disposed offsite). The APL is then treated in an activated carbon system.

NAPL Treatment

During the early remedial operations at the site, NAPL was transferred by tanker truck to OCC's Buffalo Avenue Plant in Niagara Falls for incineration. Since 1996, OCC transports the NAPL via trucks to Laidlaw Environmental Services in Deer Park, Texas, for incineration.

Lake Ontario TCDD Bioaccumulation Study

The APL Plume Flux Action Level for TCDD in the RRT Stipulation is 0.5 g/yr. TCDD is presently found in fish in levels which require the issuance of Federal (e.g., Food and Drug Administration (FDA) Advisory for fish including contaminants of TCDD), State (e.g., New York State Department of Health fish consumption advisories), and Canadian fish health advisories. At the time of the development of the RRT, there was no consensus in the scientific community on the bioaccumulation of dioxin in fish. Without this consensus, fish uptake of TCDD could not be

calculated. Therefore, the RRT required that EPA, New York State and OCC perform a Lake Ontario TCDD Bioaccumulation Study in order to determine a bioaccumulation factor for TCDD specific to Lake Ontario. The results of this study would then be used to re-examine the TCDD APL Plume Flux Action Level.

EPA Region 2, New York State and OCC designed and implemented a work plan to collect fish and sediment samples from Lake Ontario and analyze them for TCDD. Lab studies were performed by EPA's Duluth lab and the University of Minnesota. The draft Lake Ontario TCDD Bioaccumulation Study was completed in July 1989 and distributed for scientific peer review. The final TCDD Bioaccumulation Study report reflecting the comments of the peer reviewers was released to the public in September 1991.

As part of this study, EPA's Large Lakes Research Station in Grosse Isle, Michigan, collaborated with Manhattan College's Department of Environmental Engineering to produce the Lake Ontario TCDD Modeling Report. A mass-balance model was developed based upon models of fallout radionuclides and PCB contamination of the Great Lakes. The predicted steady-state TCDD concentrations for an input comparable to the TCDD APL Plume Flux Action Level of 0.5 g/yr are 0.026 nanograms/year (sorbed sediment concentrations) and 9.5×10^{-5} picograms/liter (water column dissolved concentration).

The TCDD Study, together with the model, indicated that TCDD was bioaccumulating in the tissues of various species of Lake Ontario fish at a range of rates such that the overall TCDD APL Plume Flux Action Level of 0.5 g/yr stipulated by the RRT remains protective.

Landfill Cap

The Settlement Agreement required OCC to cap the landfill with 36 inches of clay and with a 12-inch vegetative cover. Before a final cap could be placed on the landfill, wastes associated with remedial activities needed to be managed. OCC developed the Waste Disposal Plan, which was implemented in 1988. Waste disposal cells lined with clay were constructed on top of the landfill to consolidate wastes resulting from remedial actions and investigations conducted at the site. Contaminated soils from investigative activities and sediment from the Bloody Run remediation were consolidated in the landfill. The perimeter cap of the landfill was completed in 1991, and the entire landfill was capped in 1994. The final cap consisted of the following: low-permeability clay; a synthetic membrane; a drainage layer and topsoil seeded with native vegetation for barrier protection. EPA routinely inspects the landfill cap for erosion.

Community Monitoring Program

The Community Monitoring Wells, a system of wells installed in 1987 throughout the neighborhood, provide early warning of the presence of Hyde Park contaminants in the groundwater. These wells are sampled and analyzed quarterly. Should contamination be detected, OCC must take further remedial action. Hyde Park contaminants have never been detected in these wells. The data collected have demonstrated that the groundwater flow is vertically downward in the nearby community. EPA and New York State review the analytical results from sampling of these wells to ensure the community is being protected.

Industrial Protection Program

The Industrial Protection Program, implemented in 1987, established engineering controls to eliminate the exposure of nearby workers to contaminants present in the NAPL and APL plumes. Sumps and manholes in neighboring industries, including Grief Brothers, were sealed, eliminating worker exposure to vapors that may migrate into the sump. OCC relocated a sewer at neighboring TAM Ceramics in 1989. The College Heights sewer was remediated in 1990.

OCC purchased the Grief Brothers building in 1999. Access to this facility is now controlled by OCC. Periodic surveys of neighborhood manholes and sumps are performed to ensure the remedies remain intact.

Bloody Run Remediation

The Settlement Agreement set forth two possibilities for remedial action at the Bloody Run, sediment excavation or capping. The 1992 EPA risk assessment determined the excavation of sediments in the Bloody Run would not pose an adverse risk, would be protective of human health, and, was the preferred alternative.

OCC excavated approximately 30,000 cubic yards of contaminated sediment from the Bloody Run drainage area. The area was then backfilled and covered with riprap. This work was completed in January 1993. The Bloody Run now flows via a storm sewer which surfaces at the Niagara Gorge. The restored area was observed to have abundant vegetation during a site visit in May 2016.

Niagara River Gorge Face Remediation

Groundwater seeps from the rock at the Niagara Gorge, approximately 2,000 feet from the site. TCDD was detected in one sample from a seep during remedial investigations at 0.2 ppt. EPA and New York State determined that humans should be isolated from the seeps to prevent potential direct exposure to the contaminants. The Gorge Face Seeps were remediated in 1988, except for the Bloody Run portion, which was remediated in 1994. Access by humans to the seeps has been prevented by the installation of fences and the diversion of seeps into culverts. All contaminated sediments were scraped away. The pumping of the APL wells has strongly influenced the seeps, drying many. Annual inspections of the Gorge Face are conducted by representatives of EPA, New York State and OCC. The most recent inspection conducted in May 2016 confirmed that conditions in the gorge remain unchanged and no repairs are required.

As part of the Niagara River biomonitoring program, the Ontario Ministry of the Environment (MOE) collected surficial sediment samples at the base of the Bloody Run, as well as samples of caged mussels kept in the river near these sediments. In September 1997, mussels were kept in cages in the river near the mouth of the Bloody Run for 21 days, and then harvested. Sediment was collected at this location. Mussels and sediment were sent for laboratory analysis. The report Niagara River Mussel Biomonitoring Program, 1997, dated September 1999, indicates that concentrations of dioxins and furans in sediment and mussels are lower than pre-remediation levels. The report suggests that the remedial action taken to cover contaminated sediment on the river bank has reduced the bioavailability of the dioxins and furans present. However, the MOE

raised concern that these levels were higher than in other Great Lakes basins. TCDD was found in sediment at 45 parts per billion (ppb) in the MOE sampling results.

In order to verify if TCDD was present in sediments at the mouth of Bloody Run, EPA collected three sediment samples in 1999. TCDD was detected in one of these samples at 14 ppb. EPA's 1997 OSWER Directive regarding exposures to dioxins established a cleanup goal of 1 ppb for residential properties. The Bloody Run has limited accessibility based on a number of factors including:

- The limited amount of sediment an angler may be exposed to in the event that they were to stand on the shoreline and fish;
- The daily fluctuations in the volume of water in the Niagara River based on the operations of the Robert Moses Power Plant;
- The sediment is covered by surface water early in the morning and remains covered until after dark because of the release of water from the Power Authority into the Niagara River. These releases raise the level of the river by several feet making direct exposures to sediment unlikely; and,
- A platform was constructed by the river so that anglers can use this location to fish without hiking down to the sediment area.

Intermediate and Deep Bedrock Formations Study

The Intermediate and Deep Formations Study was designed to determine if contaminants from the Hyde Park Landfill had penetrated the Rochester Shale (aquitard) formation below the Lockport Dolomite. If action levels documented in the RRT Stipulation are exceeded in the Intermediate Formations, then monitoring wells will be installed in the Deep Formations. In addition, a total flux to the Niagara River is calculated, and if the Flux Action Levels are exceeded, further remedies would be required to reduce the loading to the river.

Monitoring wells were installed in the intermediate formations in 1990 without detecting the presence of NAPL. Most wells contained insufficient volumes of groundwater for sample collection after purging activities, indicating that the shale is a good aquitard. The *Monitoring Report, Intermediate Formations Wells, November 1991/1992* summarizes the results of the investigation. Most of the parameters were not detected above the survey levels determined in the RRT Stipulation. However, phenol, total organic halogens, Aroclor 1248 (a commercial mixture of PCBs) and conductivity did exceed the survey levels. OCC calculated a flux in the monitoring report which was four to five orders of magnitude below action levels.

OCC was not required to install monitoring wells in the Deep Formations because the Intermediate Formations' investigation indicated that Hyde Park contaminants had not migrated through the shale and were not present in the Intermediate Formations.

Additional Remedial Action

OCC has performed additional remedial actions at the site in addition to those previously discussed. The onsite lagoons were remediated in 1991. NAPL in the lagoons was pumped into the leachate storage facility and the lagoons were closed. NAPL was also pumped from four

railroad tank cars, which had been used onsite for years as storage for NAPL generated from remedial investigations because there was no facility permitted to destroy dioxin through incineration. In 1991, the tank cars were placed in the waste disposal cells which were constructed as part of the landfill cap.

OCC also remediated sewers in the area. Sewers provided preferential pathways for contaminants to migrate through the overburden. As previously mentioned, OCC relocated a sewer at TAM Ceramics and remediated the College Heights sewer. The remediation of the University Drive (bordering Niagara University) sewer was completed in August 1993. NAPL contaminated soils were removed from under University Avenue; these soils were placed in a waste disposal cell at the landfill, prior to installing the final cap.

Site Re-Characterization

OCC performed a detailed groundwater modeling study of the site during 2000-2001 to address uncertainties with respect to groundwater flow and evaluate the performance of the bedrock remedial system. The site is located in a very complex hydrogeologic setting and OCC sought to formulate a conceptual model which synthesized data collected from the site and the regional hydrogeologic setting. Particle tracking was utilized to determine the capture zones of the existing bedrock wells. The model indicated that there was a vertical component of flow (i.e., some of the water from the Upper Bedrock zone was being captured in the Lower Bedrock zone).

Subsequent to the development of the groundwater model, OCC revised the site conceptual model which provided the basis for the numerical simulation of the hydrogeologic system. OCC conducted field investigations from 2001 to 2003, including down-borehole geophysics and water-level measurements in 113 piezometers (retrofitted monitoring wells.) The analysis of the field data resulted in a revised hydrolgeologic framework consisting of eleven discrete flow zones separated by aquitards. OCC has documented its revised hydrogeologic framework in two documents: *Site Characterization Report: Revised Geologic and Hydrogeologic Characterization* (February 2002) and *Site Characterization Report: Hydrologic Characterization* (February 2003).

The eleven flow zones replaced the Upper, Middle and Lower Bedrock framework formerly used at this site. Groundwater monitoring has been conducted in the eleven flow zones since late 2002 and OCC has built a data base of water-level measurements.

After the geology at the site was re-characterized, OCC revised their groundwater model to assist them in determining if the groundwater remedy provides capture of the contaminated water associated with the site. OCC issued the *Site Characterization Report: Groundwater Flow Model* in June 2003. The results of the groundwater model indicate that capture of contaminated groundwater is achieved in the bedrock.

OCC issued the *Site Characterization Report: Remedial Characterization Report* (RCR) which concludes that the Bedrock NAPL Plume Containment System satisfies the performance objectives of the RRT (inward gradient). Although the data for two of the flow zones suggest some uncertainty in the inward gradient, chemical analyses of the groundwater from these two zones indicate that site-related contaminants are not present in this groundwater. This indicates that no migration of contaminants outside of the containment system is occurring.

In November 2003, OCC issued the *Major Ions Study*. This report concluded that sulfate ions are an indicator of the relative age of groundwater and that the vertical and horizontal distribution of sulfate ions near the site support the revised conceptual model of groundwater flow. Sampling results from the Gorge Seeps indicate that the seeps appear to originate primarily from surface runoff (water of a very young age) and not water which has migrated from the site (water of an older age).

OCC issued the *Comprehensive Remedial Characterization Report* (CRCR) in August 2004. This report concludes the conventional hydraulic performance monitoring requirements defined in the RRT were not suitable for the site because of the complex hydrogeologic complexity of the Lockport bedrock which was poorly understood when the RRT Stipulation was issued. EPA recognizes that there may be concerns with conventional monitoring approaches in *Elements for Effective Management of Operating Pump and Treat Systems* (542-R-02-009 OSWER 9335.4-27FS-A) and recommends utilizing converging "lines of evidence" for containment demonstration. OCC adopted this approach for the performance evaluation documented on the CRCR. Several lines of evidence were selected for the performance evaluation:

- Flow directions interpreted from potentiometric surface maps;
- Flow directions estimated from vertical gradients;
- The distribution of site-related parameters in groundwater;
- The distribution of major ions and the relative age of groundwater; and,
- Groundwater-flow modeling.

Following these lines of evidence, the Bedrock NAPL Plume Containment System satisfies the performance objectives of the RRT Stipulation and the containment objective is maintained year-round. The Bedrock NAPL Plume Containment System has been maintained and upgraded continuously since 1993.

Systems Operation/Operation and Maintenance (O&M)

OCC conducts extensive operations and maintenance (O&M) at the site. The carbon beds at the treatment facility are routinely changed and regenerated. The sacrificial carbon beds must also be changed and disposed. OCC conducts influent and effluent analyses to ensure compliance with the discharge permit. OCC monitors the effluent from the treatment facility and prepares daily, weekly and quarterly Treatment System Effluent Monitoring Data Reports.

Quarterly groundwater sampling is performed. Hydraulic and chemical data are collected and analyzed. These results are documented in a Quarterly Report. OCC collects water-level elevations in the 11 flow zones and in the overburden on a quarterly basis and presents potentiometric-contour maps and water-elevation summaries in the Quarterly Reports.

OCC performs extensive well and pump maintenance because NAPL often fouls wells and pumps.

OCC performs a biannual Gorge Face Seep Survey to ascertain that the remedial actions taken in the Gorge remain protective of human health and the environment.

Potential site impacts from climate change have been assessed, and the performance of the remedy is currently not at risk due to the expected effects of climate change in the region and near the site.

Progress Since Last Review

Protectiveness statement(s) from previous five-year review: The remedy at the Hyde Park Landfill Superfund site protects human health and the environment. There are no exposure pathways that could result in unacceptable risks, and none are expected as long as the engineered controls currently in place continue to be properly operated, monitored, and maintained.

Recommendations identified in previous five-year review: There were no recommendations or follow-up actions resulting from the previous five-year review.

Five-Year Review Process

Administrative Components

The Five-Year Review Team consisted of: Gloria M. Sosa (Remedial Project Manager), Edward Modica (Hydrogeologist), Marian Olsen (Human Health Risk Assessor), Mindy Pensak (Ecological Risk Assessor), Mike Basile (Community Involvement Coordinator), and Peter Mannino (Western New York Remediation Section Chief). This is a PRP-lead site.

Community Involvement

On November 19, 2015, EPA Region 2 posted a notice on its website indicating that it would be reviewing site cleanups and remedies at 32 Superfund sites and four federal facilities in New York and New Jersey, including the Hyde Landfill Park site. The announcement can be found at the following web address: http://www2.epa.gov/sites/production/files/2015-11/documents/fy_16_fyr_public_website_summary.pdf.

EPA posted the public notice that it would be conducting a five-year review for Hyde Park Landfill to the City of Niagara Falls website and also to the Bulletin Board at City Hall. Once the five-year review is completed, the results will be posted electronically online at http://www.niagarafallsusa.org and will also be made available for public viewing at the US EPA Region 2 Western New York Public Information Office, 186 Exchange Place, Buffalo, New York. The telephone number of the local site repository is 716-551-4410.

In addition, efforts will be made to reach out to local public officials to inform them of the results of the five-year review.

Document Review

The documents, data and information which were reviewed in completing this five-year review are summarized in Table 2.

Data Review

The 2006 Performance Monitoring Plan (PMP) outlines the monitoring requirements for the site. The PMP requires annual assessment of the following three monitoring programs:

- Overburden Monitoring Program
- Bedrock Monitoring Program
- Community Monitoring Program

The results of these three monitoring programs are submitted in an Annual Site Remedial Performance Evaluation Report. This report also includes an assessment of the Treatment System Monitoring Program.

Overburden Monitoring Program

The Overburden Monitoring program involves the monitoring of the Source Control (SC) Wells and the Overburden Collection System. The SC Wells are a series of production wells installed within the landfill to recover NAPL, while the Overburden Collection System is comprised of a pair of French-drain systems designed to control the lateral migration of dissolved phase constituents and NAPL in the overburden.

The overburden groundwater elevation data are measured on a quarterly basis and are used to determine whether hydraulic containment is maintained over the landfill area. Groundwater potentiometric surface maps are generated every quarter to help make this determination. For the 2011-2015 five-year-review period, the overburden potentiometric surface maps indicate that containment has generally been maintained with lowest groundwater elevations centered over the northwest section of the landfill.

Pumping data for the 2011-2015 period indicate that the SC wells do not appear to be yielding as much NAPL compared to combined APL/NAPL recovered. For example, in 2014, an estimated 48 gallons of NAPL were collected compared to the 265 gallons of combined APL/NAPL purged from the SC wells, indicating that the majority of material removed from the wells is APL, and not NAPL. Further, the combined APL/NAPL production by SC wells in recent years (265 gallons in 2014) has declined compared to production in 2006 (799 gallons).

NAPL presence checks are completed annually in the Overburden Barrier Collection System (OBCS), Overburden Monitoring Wells (OMWs) and the OBCS manholes (*see Figure 2*). The NAPL presence monitoring data from the OMW wells and manholes indicate that NAPL is present in three to five of the 17 manholes monitored in a given year (MH-29, MH-30, MH-31, MH-32, and MH-33) and in well WW-D for several years of this five-year-review period. The manholes and wet well are located near the southwest comer of the landfill. However, NAPL is not present in OMW-9, -11R, -12R, -13R, and -14R, wells that are located outside of the OBCS to the west and southwest of the manholes with NAPL present. The lack of NAPL presence in these OMW wells indicates that any Overburden NAPL is contained within the boundaries of the OBCS and is not bypassing the OBCS. Based on the overburden data collected, the overburden monitoring systems are operating properly and overburden containment is being achieved.

Bedrock Monitoring Program

The Bedrock Monitoring program (*see Figure 3*) includes the Lockport Bedrock APL and NAPL Plume Containment Systems and the Bloody Run Creek Monitoring Program. The Lockport Bedrock APL and NAPL Plume Containment Systems consist of 19 purge wells that control lateral migration of dissolved phase constituents and NAPL in the bedrock, while the Bloody Run Creek Monitoring Program ensures that contaminant migration via the Bloody Run Creek remains under control.

Bedrock purge well flow-rate data for the 2011-2015 period indicate that purge well flow rates were consistent with historical flow rates and that water levels were maintained within the acceptable target setpoint ranges at each of the purge wells. The water level in flow zone nine (FZ-09) in the area between the landfill and the APL purge wells, APW-1 and APW-2, is maintained at an elevation of 526 feet above mean sea level (AMSL) or lower to ensure that the FZ-09 outcrop along the New York Power Authority (NYPA) access road remains unsaturated. The bedrock flow zone groundwater elevation data were used to generate groundwater potentiometric surface maps for each of the eleven monitored flow zones (FZ-01 to FZ-11). The quarterly potentiometric surface maps for each monitored flow zone indicated containment relative to the NAPL limits established in each flow zone.

Groundwater samples are collected quarterly for organic acids, and collected every '5th Quarter' for a more comprehensive list of chemical constituents (volatile organic compounds (VOCs), semi-volatile organic compounds (SVOCs), organic acids, and sulfate). Sampling results are compared to the Site Organic Indicators (SOI) chlorendic acid, benzene, 1,1,2,2-tetrachloroethane, tetrachloroethylene (PCE), trichloroethylene (TCE), *cis*-1,2-dichloroethene (cis-1,2-DCE), and vinyl chloride. For the past five years, exceedences to the established screening levels for SOIs were reported at several locations for chlorendic acid (up to 500 ppb), benzene (up to 150 ppb), 1,1,2,2-tetrachloroethane (up to 78 ppb), PCE (up to 15 ppb), TCE (up to 95 ppb), *cis*-1,2-DCE (up to 110 ppb), and vinyl chloride (up to 57 ppb). In addition, there were several locations where non-SOI parameters were reported to exceed screening levels, the chemical constituent 1,1,2-trichloroethane (1,1,2-TCA) (up to an estimated 9.7 ppb), chloroform (up to 210 ppb), and bis(2-ethylhexyl)phthalate (up to an estimated 18 ppb). However, no appreciable trends in concentrations of chemical constituents have been noted. Non-SOIs are hypothesized to be from other sources in the area. Concentrations are not expected to change significantly until NAPL is recovered. Sulfate concentrations had also been reported at consistent levels (up to 2,000 ppm); the data indicating that the age of the water in the seeps is relatively new (surface water infiltration) and not groundwater from the landfill, which would have a relatively older age.

The Bloody Run Creek Monitoring Program is required to be monitored every five years. The Creek was last monitored in August of 2011. Analyses included VOCs, SVOCs, and organic acids. Bloody Run sampling event data indicate that chlorendic acid exhibited an exceedance (up to 0.34 ppb) at the wells BR-2, BR-3, and BR-4.

The water-quality, water-level, and pumping-rate data collected for the 2011-2015 period demonstrate that the bedrock APL and NAPL purge well systems are operating properly, and

containment is being maintained in each of the flow zones. No changes to the bedrock purge or monitoring systems are needed at this time.

Community Monitoring Program

The Community Monitoring program was developed to ensure that the public is not being adversely exposed to site-related parameters. The Community Monitoring program includes the Gorge Face Seep Program, the APL Flux Monitoring Program, and the Residential Community Monitoring Program. The Gorge Face Seep Program involves biennial inspections of the Niagara River Gorge to ensure that site-specific parameters are not discharging to a publicly accessible area. The APL Flux Monitoring Program ensures that the mass loading via groundwater discharged to the Niagara River Gorge is less than the defined Flux Action Level. The Residential Community Monitoring Program ensures that residents, in the area are not adversely exposed to site-related constituents in the groundwater or from soil vapors above the groundwater.

Gorge Face Seep: A biennial Gorge Face Seep Survey was performed on August 25, 2015. A total of 24 seep locations and 8 culverts, as well as the Garfield Street Outfall Sewer and the Bloody Run outlet, were visited and inspected for variations in flow and exposed wet areas. The results of the Survey indicate that conditions in the Gorge have not changed since the previous survey in 2013 and that no additional remedial actions are necessary. Sampling of the seeps was temporarily suspended after the 2011 survey because of the large number of non-detect samples at all seeps. Sampling of the seeps will not be required unless conditions change in the Gorge. The next seep survey is scheduled for 2017.

APL Plume Flux Sampling: APL plume flux composite sampling is performed quarterly. If APL plume flux parameters (for select polychlorinated biphenyls, pesticides, and dioxin furans) are detected above their respective reporting levels, calculation of the flux to the Niagara River Gorge is required. Calculation of the flux to the Niagara River Gorge was not required from 2011 through 2015.

Quarterly Hydraulic Gradient: Water level elevations and vertical hydraulic gradients are measured at eleven paired community monitoring wells on a quarterly basis. For the period between 2011 and 2015, downward vertical hydraulic gradients were consistently maintained at each of the well pairs throughout each year.

Soil Vapor Monitoring: Annual soil vapor monitoring is performed at six locations near the Hyde Park Landfill. For the 2011-2015 period there were no exceedances (greater than 0.050 part per million per volume (ppmv) above background) of total VOCs reported for any of the soil vapor monitoring locations. Although some elevated Organic Vapor Analyzer readings were reported for the 2014 sampling event, the readings were considered anomalous and were attributed to instrument error.

NAPL Presence Monitoring: The annual NAPL presence check was conducted at the catch basin on the north side of the Greif Brothers building on October of each year between 2011 and 2015. NAPL was not present in the catch basin at these times. In addition, the PMP requires annual collection of an APL sample from the open catch basin and analysis of that sample for organic

acids. The APL samples were collected on October of each year. These data indicate no exceedances of the site screening levels. All organic acid parameters were non-detect.

Treatment System Monitoring and Maintenance Inspections

The systems have been appropriately monitored and maintained since the last five-year review. Maintaining the site remedial elements is critical to the remedial performance. As a result, daily, weekly, and monthly inspection of the monitoring points (wells and piezometers), the landfill cap, and the security fence surrounding the landfill have been included in the PMP.

Annually, the active monitoring wells and piezometers are inspected to ensure that the casings and caps are secure and in good condition. Also, well depths are monitored for possible infilling. Maintaining the landfill cap minimizes the potential for a breach of the cap and ensures a long operational life. The cap is routinely inspected during the quarterly sampling events.

Site Inspection

The inspection of the site was conducted on May 2, 2016. In attendance were: Gloria M. Sosa, EPA; Brian Sadowski, New York State Department of Environmental Conservation (NYSDEC) Region 9; Joseph Branch, Glenn Springs Holdings, Inc. (representing OCC), and, John Pentilchuk, GHD (contractor to GSHI). The purpose of the inspection was to assess the protectiveness of the remedy. The site condition was excellent.

Interviews

No interviews were conducted for this review**.**

Institutional Controls Verification

A Declaration of Restrictive Covenants and Environmental Easement was placed on the deed to the site property at the County recording office in Niagara County on October 7, 2010. The Grantor (Occidental) grants a permanent restrictive covenant and an environmental easement to the Grantee (Town of Niagara) to provide a right of access over the approximately twenty-one acre property (the "Property") for purposes of implementing, facilitating and monitoring the remedial action. The covenant/easement also imposes on the Property certain use restrictions that will run with the land for the purpose of protecting human health and the environment in the future.

The following restrictions apply to the use of the Property, run with the land, and are binding on the Grantor: the Property shall not be used in any manner that would interfere with or adversely affect the implementation, integrity, or effectiveness of the remedial action performed at the site, including, but not limited to: a) the extraction of on-site groundwater; b) any digging, excavation, extraction of materials, construction, or other activity outside the requirements of the remedial action that would disturb the cap placed upon the landfill at the site; or c) other activity that would disturb or interfere with any portion of the remedial action for the site enumerated in the RRT Stipulation. The Property also may not be used for residential use. However, the Property may be used for commercial or industrial use as long as long-term engineering controls are employed and remain effective. That is, specifically, the operation of the portion of the response action pertaining

to the pumping of the extraction wells, the operation of the treatment facility, and maintenance of the landfill cap.

In addition to the site-specific institutional control, the Niagara County Department of Health imposes restrictions on the drilling and usage of groundwater wells at the site. These restrictions ensure that drinking-water wells are not installed in areas of contaminated groundwater, effectively preventing exposure to site-related contaminants through direct contact (e.g., ingestion, inhalation, and dermal contact).

Technical Assessment

Question A: Is the remedy functioning as intended by the decision documents?

The remedy for the Hyde Park Landfill site as set forth in the EDD calls for hydraulic containment and collection of contaminated groundwater (APL) and NAPL in the overburden and fractured-carbonate bedrock aquifer (Lockport Dolomite) beneath the landfill. The EDD recognizes that the APL and NAPL plumes would not be remediated to drinking water standards due to the persistence of NAPL at the site. Consequently, the remedial action objective focuses on the hydraulic containment of the APL plume that surrounds the landfill and the reduction of NAPL to reduce the driving force and prevent further migration. Various monitoring programs have been established for the overburden, the bedrock, and the residential community next to the site to evaluate the performance of the remedy and ensure that the components of the remedy are functioning properly. Based on an evaluation of data from these programs, the remedy is functioning as intended by the decision documents.

Overburden Containment

The overburden containment system consists of source control wells that are used to recover NAPL/APL within the landfill. The OBCS controls the lateral migration of NAPL and APL in the overburden, and consists of a system of French drains and sumps encircling the landfill. The overburden NAPL/APL plume containment system has been operating since 1991 and has been performing consistently to prevent lateral migration of contaminated groundwater.

Data collected for the Overburden Monitoring Program for the last five years indicate that the source control purge wells are generally effective in removing liquid wastes (NAPL and APL) from within the landfill. However, total gallons purged on a monthly basis have declined from 799 gallons in 2006 to 265 gallons reported in 2014. Furthermore, based on water level and NAPL thickness data, it appears that the Source Control wells are no longer producing significant amounts of NAPL. Based on water-level data from piezometers, the potentiometric surface in the overburden shows that the plume is contained. The NAPL Presence Monitoring shows that NAPL does not bypass the OBCS and detected NAPL is consistent with historical data. Thus, the containment system for the overburden operates properly and containment is being achieved.

Bedrock Containment

The bedrock NAPL/APL plume containment system has been designed to prevent lateral migration of groundwater in the bedrock by creating inward and downward flow gradients. Prior to 2002, it could not be demonstrated that full containment had been achieved in the bedrock aquifer. Investigative studies conducted in 2002 and 2003, which were aimed at re-characterizing the Lockport bedrock, showed that the bedrock consists of multiple discreet bedding-parallel flow zones. As a result, plume boundaries were re-defined for each flow zone, previously-installed wells were retrofitted to communicate with specific flow zones, and the Bedrock Monitoring Plan was modified to reflect the updated understanding of the bedrock flow system.

The Bedrock Monitoring Program involves the evaluation of water levels, fluxes, and water quality of wells screened in discreet fracture zones in the Lockport Bedrock. Nineteen purge wells are used to control the lateral migration of APL/NAPL in the bedrock. Potentiometric data collected for the past five years indicate that the contaminant plume within each flow zone is contained by groundwater flow gradients, and that the purge well flow rates have been consistent with historic values and the purge well system operates as designed.

In the bedrock plume containment system, hydraulic containment is implemented by controlling water levels at target set points. Based on the past five years of data, the pumping level set points for wells are all maintained within an acceptable operating range. To control flow migration in the area between the landfill and wells APW-1 and APW-2 (outcrop along New York Power Authority access road). Unsaturated conditions need to be maintained in Flow Zone 09 in this area by keeping water levels at or below the elevation of 526 feet. Water levels have been consistently maintained below 526 feet, and for the past five years have averaged close to 518 feet.

Groundwater samples are collected quarterly for organic acids, and collected every ‘5th Quarter’ for a more comprehensive list of chemical constituents (VOCs, SVOCs, organic acids, and sulfate). Sampling results are compared to the SOI chlorendic acid, benzene, 1,1,2,2-tetrachloroethane, PCE, TCE, *cis*-1,2-DCE, and vinyl chloride. For the past five years, data from these sampling events show that several locations exhibit exceedences to the established screening levels for some SOIs as well as for some non-SOIs, such as 1,1,2-TCA, and chloroform. Non-SOIs are hypothesized to be from other sources in the area. However, no appreciable trends in concentrations of chemical constituents have been noted. Concentrations are not expected to change significantly until NAPL is recovered.

Another component of the Bedrock Monitoring Program involves monitoring Bloody Run Creek, which is monitored every five years to confirm that contamination via the creek remains under control. Analysis includes VOCs, SVOCs, and organic acids. The Creek was last monitored in August of 2011. The results from the sampling event indicated that there were minor exceedences of chlorendic acid in the wells BR-2, BR-3, and BR-4. The next monitoring event is scheduled for October 2016.

Community Monitoring

The Community Monitoring Program has been put in place at the site to provide early warning to the residential community and make certain that residents in the area adjacent to the landfill are not adversely exposed to contaminants in groundwater or from soil vapors above groundwater. Results from the last five years of hydraulic measurements in paired community monitoring wells near the landfill show that downward and vertical gradients are maintained at each well pair. Results of soil vapor monitoring for the same period show that there were no exceedences (greater than 0.05 ppmv above background) of total VOCs at any soil monitoring locations.

The Community Monitoring Program includes annual APL flux monitoring to ensure that mass loading via groundwater discharge to the Gorge is less than the defined Flux Action Level as documented in the RRT Stipulation. Data for the last five years show that no APL plume flux parameters (i.e., PCBs, pesticides, dioxin and furans) were detected above their reporting limit, consequently calculations of flux to the Niagara River Gorge were not necessary.

An annual NAPL presence check is conducted at the catch basin on the north side of the former Grief Brothers building. For the past five years NAPL has not been present in the open basin. An annual APL sample from the basin and analysis of the sample for organic acid is also required. Based on sampling data for the past five years, there were no exceedences of screening levels and organic acid parameters were not detected.

The Community Monitoring Program also calls for a biennial inspection of the Gorge Face to ensure that contaminants are not discharging to public access areas. Gorge Face Seep surveys were conducted in 2011 and 2015. For each survey, previously identified seep locations or wet areas were inspected and notes were made regarding flow, vegetation, and odors. Based on surveys performed to date, there were no significant changes noted from previous surveys arid no recommendations for groundwater sampling.

Maintenance & Inspection

Regular inspection and maintenance of the landfill cap ensures that the cap is in good working order and works to significantly reduce leachate. The cap is inspected annually and, based on the recent maintenance records, is in good working condition with no major subsidence concerns. The site wells and piezometers are routinely inspected to confirm that casings and caps are secure and in good working condition. The well depths are also sounded to confirm that infilling is not taking place. A perimeter fence had been installed to prevent access by trespassers. The fence is inspected on weekdays and appears to be in excellent condition.

Question B: Are the exposure assumptions, toxicity data, cleanup levels, and remedial action objectives used at the time of the remedy still valid?

The risk assessment for exposure to contaminated sediments from the previous five-year review was updated to reflect changes in toxicity information for dioxin e.g., the availability of an oral RfD for TCDD and updates to the standard defaults used in EPA's Superfund risk assessments (OSWER Directive 9200.1-120 and the EPA Exposure Factors Handbook of 2011). Based on the limitations in accessibility identified above, the human health risk assessment assumed exposures

to an adolescent (12 to 18 years of age) and an adult (older than 18 years). The assessment assumed an Exposure Durations for the adolescent of six years and for the adult of 20 years. Exposure frequency was assumed to be 13 days/year over the Exposure Duration period of 26 years. The assumption of 13 days/year reflects one day per week for the 13 days of summer (e.g., June through August). Adolescent anglers, are expected to be exposed to sediment for a limited time each year, considering school attendance and other activities. Adults and adolescents would further be limited in their exposures based on winter conditions that prevent year round access. The risk calculations assumed the anglers exposed skin surface is limited to the head (face), hands, forearms, lower legs, and feet. Based on the available sediment area, the risk calculations may be overestimated based on the limited amount of sediment available for direct contact.

The assessment found that the calculated cancer risks based on these assumptions were within the risk range of 10^{-4} (1 in 10,000) to 10^{-6} (one in a million) and below the non-cancer Hazard Quotient (HQ) = 1. The results of this analysis indicated that under the exposure assumptions described above the remedy remains protective.

In 2013, EPA conducted a focused screening of the ecological risk from PCBs and dioxin contamination in Bloody Run Creek and Niagara River to evaluate the potential ecological risks of receptors. This report was prepared in accordance with ecological risk assessment guidance (USEPA 1997, 1998). The area of concern for this focused screening is Bloody Run Creek and Niagara River. The potential risk from exposure to dioxin and PCBs in sediment and consumption of contaminated mussel tissues was evaluated for ecological receptors including benthic invertebrates, fish, aquatic birds and mammals. Ecological receptors using Bloody Run Creek and Niagara River may be exposed to dioxin and PCBs through direct contact with or incidental ingestion of sediment and surface water. Receptors may also be exposed to these contaminants through dietary transfer from consumption of contaminated mussel tissues at the aquatic habitat.

The results from this focused screening indicate that there is potential for risk to ecological receptors exposed to dioxin and PCBs in sediment at the Bloody Run Creek and Niagara River and dioxin in the groundwater from bedrock along the Bloody Run Creek. Dioxin and PCBs concentrations measured for the site-specific groundwater and sediment samples exceeded screening benchmarks for both dioxin and PCBs in sediment, and dioxin in groundwater from the monitoring wells installed in bedrock along the Bloody Run Creek.

HQs for sediment dioxin and PCBs were greater than 1, indicating potential risks to ecological receptors at the site. In addition, the results of food chain modeling indicate the potential for risk to insectivorous birds (tree swallow), piscivorous birds (great blue heron) and piscivorous mammal (mink) exposed to dioxin at the site. This focused screening indicated that concentrations of dioxin in the sediment and groundwater at the Bloody Run Creek and Niagara River are sufficiently high to present risk to certain ecological receptors.

However, the exposure routes to the ecological receptors are not complete. Bloody run has been remediated. Groundwater associated with Bloody Run and the site is being captured by the bedrock remedial system. The sediments at the shoreline of the Niagara River are exposed daily for only a very short period of time as the river shoreline fluctuates in response to the pumping at the nearby

hydroelectric dam and these sediments are covered. In summary, ecological receptors are not being exposed to site contaminants.

Changes in Risk Assessment Methods

There are no changes in the site physical conditions over the past five years that would change the protectiveness of the remedy. The site has limited access based on its location within an industrial area, fencing, and security guards that would interrupt potential exposures. In addition, the cap over the landfill serves as a barrier to direct exposure to soil and contaminated groundwater.

The establishment of an inward groundwater gradient on site along with on-going monitoring within the community to assure contaminants do not migrate off site prevent potential exposures to groundwater. In addition, Niagara County Department of Health has restrictions to prevent drilling wells for the purpose of a drinking water source which further interrupts potential exposure to the APL/NAPL contaminated groundwater. These actions prevent potential exposures to contaminants of concern (COCs) identified in the 1985 EDD.

Currently, New York State Department of Health issues fish advisories for the Niagara River, downstream of the Niagara Falls and Lake Ontario. The advisories include an “eat none” for women under 50 years and children under 15 years of age. Recommendations for specific fish species consumption and numbers of meals are identified in the New York State Fish Advisories based on the age of the receptor and number and type of fish consumed. The advisories aid in interrupting potential exposures to contaminated fish.

Vapor intrusion was evaluated in the previous five-year review. Stipulations in the RRT, and the O&M Plan require updates to EPA regarding changes in property ownership where buildings may be built without consideration of vapor intrusion, The RRT also stipulates that the Town of Niagara and the City of Niagara Falls notify EPA and NYSDEC of all applications for permits for construction activities. In the event that there are any plans for construction in the future, notification of EPA and the State of New York will assure appropriate measures are taken to prevent potential exposures through vapor intrusion. In the event that any construction occurs on the landfill, further investigation of the potential for soil vapor intrusion needs to be conducted using the Vapor Intrusion Screening Level Calculator, including subsequent updates, to limit potential exposures through vapor intrusion.

Changes in Exposure Pathways

Potential changes in land use are not expected at this time. A Declaration of Restrictive Covenants and Environmental Easement was placed on the deed to the site property at the County recording office in Niagara County to prevent the use of the property for residential purposes. There are no changes in the human health routes of exposures that would affect the protectiveness of the remedy under current conditions and future land use is addressed through the Easement.

No new contaminants or contaminant sources were identified. There are no unanticipated toxic byproducts not previously addressed by the decision documents. There have been no changes in the conditions at the site that would affect the protectiveness of the remedy.

Changes in COCs or Contaminant Sources

No new COCs were identified. Chloroform is no longer considered a COC. There have been no changes in the contaminant sources.

Changes in Standards, TBCs and Toxicity Values

There have been changes in standards, TBCs, and toxicity values for TCDD. Previously, the EDD identified 1 ppb as the basis for remedial action in soil. EPA's dioxin reassessment has been developed and undergone review for many years, with the participation of scientific experts in EPA and other federal agencies, as well as scientific experts in the private sector and academia. The Agency followed current guidelines and incorporated the latest data and physiological/ biochemical research into the reassessment.

TCDD was identified as a main COC in fish and other media. As a part of prioritizing Integrated Risk Information System (IRIS) assessments, the need for an assessment of dioxin carcinogenicity was re-evaluated by the Agency. In 2011, EPA announced that it would conduct separate assessments for cancer and non-cancer health effects of dioxin. The non-cancer assessment was completed in 2012. The IRIS program now intends to focus on other chemical assessment needs that have been identified as higher priorities to EPA program and regional offices and will defer completion of the dioxin cancer assessment at this time. On February 17, 2012, EPA released the final human health non-cancer dioxin reassessment, publishing an oral non-cancer toxicity value, or reference dose (RfD), of $7x10^{-10}$ mg/kg-day for 2,3,7,8-tetrachlorodibenzo-*p*-dioxin in EPA's IRIS database. The dioxin RfD was approved for immediate use at Superfund sites to evaluate oral exposures and to ensure protection of human health. This change in the toxicity value does not impact the protectiveness of the remedy.

The 1985 EDD also identified perchloropentacyclodecane, Aroclor 1248, chloroform, phenol, total organic halogen, benzoic acid, monochlorobenzoic acids (sum of O, P, M isomers), and chlorendic acid as COCs. Currently, the IRIS program is evaluating the non-cancer toxicity of PCBs including Aroclor 1248 and any updated to the current toxicity values will need to be evaluated in the next five-year review. There have been no changes in the toxicity value for benzoic acid. Provisional Peer-Reviewed Toxicity Values were evaluated for 2-chlorobenzoic acid. The analysis concluded that toxicity values and surrogates is not feasible for 2-chlorobenzoic acid. The changes in toxicity values do not change the protectiveness of the remedy.

Summary

There are no changes in the physical conditions of the site or site uses that would affect the protectiveness of the selected remedy. The exposure assumptions and the toxicity values that were used to estimate the potential risks and hazards to human health and the environment followed general risk assessment practice at the time the risk assessment was performed and are generally consistent with current practice.

Question C: Has any other information come to light that could call into question the protectiveness of the remedy?

No other information has come to light that would call into question the protectiveness of the remedy. There have been no changes at the site as the result of natural disasters or climate change impacts.

Technical Assessment Summary

Based upon the results of this fifth five-year review, including a review of the site data and the site inspection, it has been concluded that the remedy is functioning as intended by the site's decision documents. There have been no changes in the physical conditions of the site that would affect the protectiveness of the remedy. The hydraulic containment stipulated in the RRT has been achieved. EPA issued a dioxin RfD in 2012. The dioxin RfD does not affect the protectiveness of the remedy because there is limited to no access or exposure to the sediment at the mouth of the Bloody Run where dioxin has been historically detected. There have been no other changes in the toxicity factors for the contaminants of concern and here has been no change to the standardized risk assessment methodology that could affect the protectiveness of the remedy. There is no other information that calls into question the protectiveness of the remedy.

Issues, Recommendations and Follow-Up Actions

There are no recommendations or follow-up actions resulting from this five-year review.

Protectiveness Statement

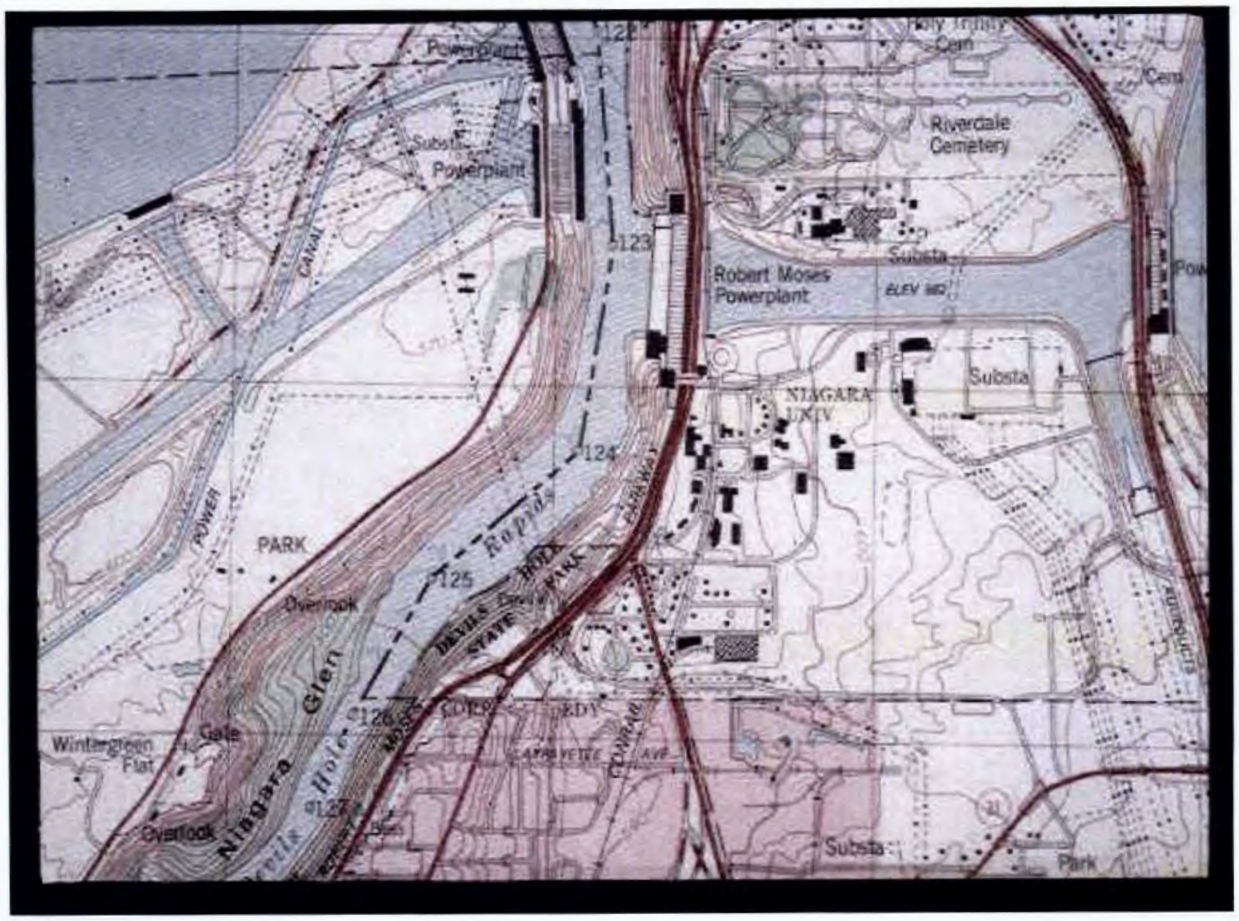
Protectiveness Statement(s)		
Operable Unit: OU1	*Protectiveness Determination:* Protective	*Addendum Due Date (if applicable):*
Protectiveness Statement: The remedy at the Hyde Park Landfill Superfund site is protective of human health and the environment.		
Sitewide Protectiveness Statement		
Protectiveness Determination: Protective		*Addendum Due Date (if applicable):*
Protectiveness Statement: The remedy at the Hyde Park Landfill Superfund site is protective of human health and the environment.		

Next Review

Since hazardous substances, pollutants or contaminants remain at the Hyde Park Landfill Superfund site, the next five-year review for the site is required five years from the completion date of this review.

Figures

Figure 1: Site Location



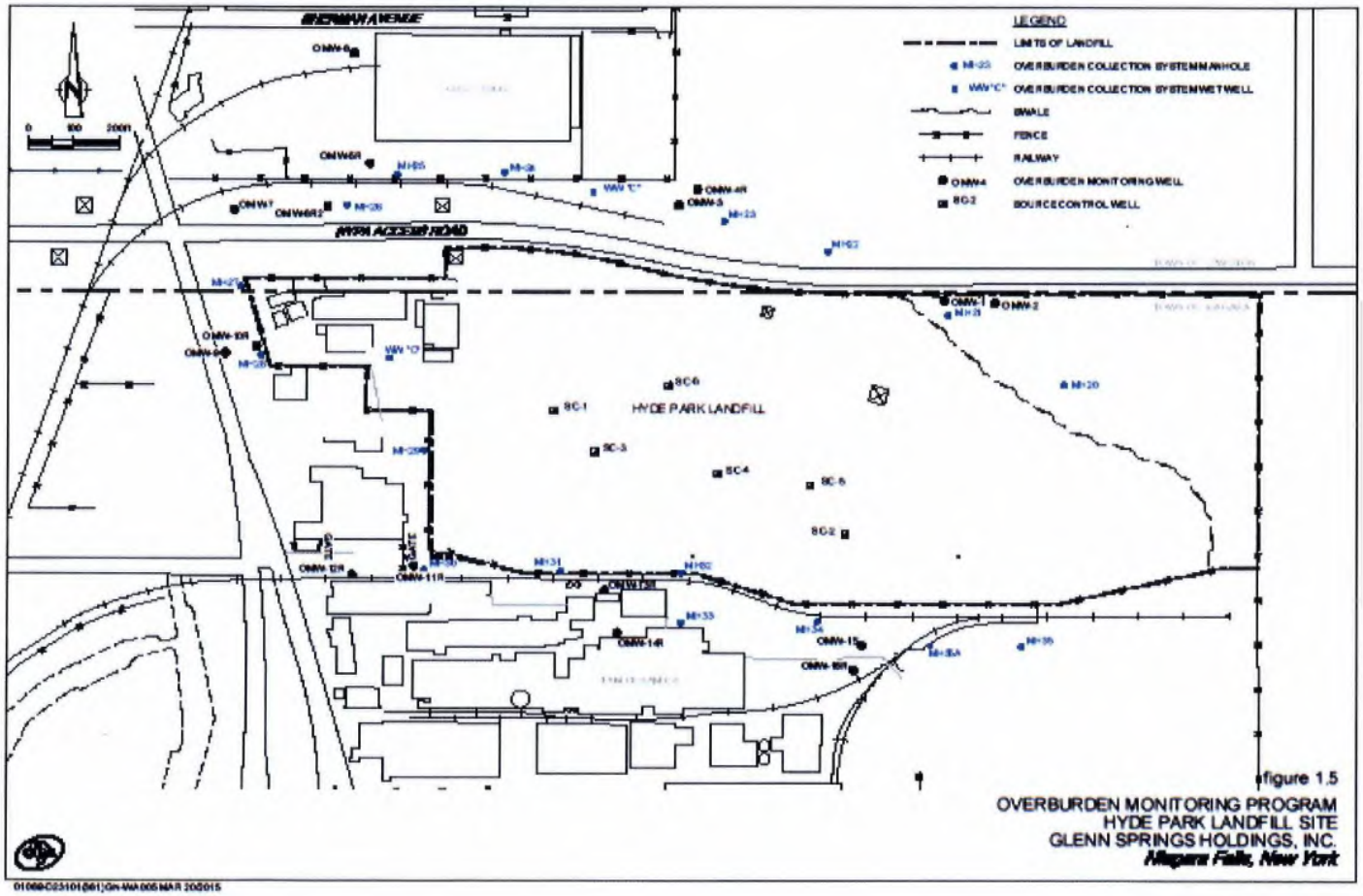


Figure 2: Overburden Monitoring Program

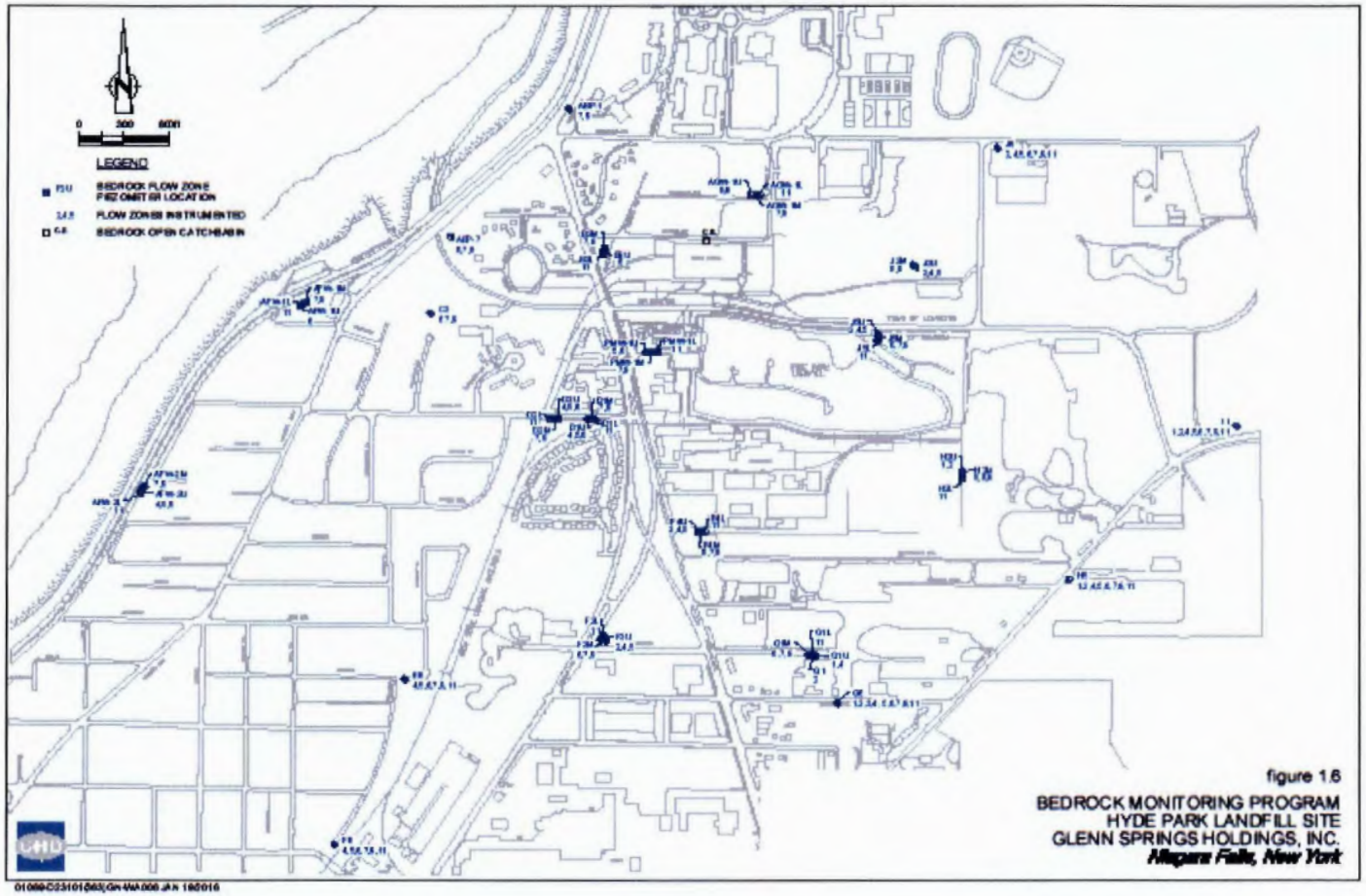


Figure 3: Bedrock Monitoring Program

Tables

TABLE 1: CHRONOLOGY OF EVENTS	
REMEDIAL ACTIVITY	**DATE**
Landfill Closed by Occidental Chemical Corporation	1975
Clay Cap Placed on Landfill	1978
Stipulation and Judgment Approving Settlement Agreement	04/82
Aquifer Survey	12/83
Enforcement Decision Document	11/85
Stipulation on Requisite Remedial Technology Program	05/86
Community Monitoring Program	04/87
Industrial Protection Program	09/87
Gorge Face Seeps Remediation	11/88
Leachate Treatment Facility	04/90
Intermediate and Deep Formations Study	09/90
NAPL Incineration Permit	11/90
NAPL Plume Containment System: Phase I Extraction Wells	11/90
Source Control: Extraction Wells	12/90
Overburden Barrier Collection System	12/91
TCDD Bioaccumulation Study released to the public	09/91
Perimeter Capping	07/91
Bloody Run Remediation	01/93
NAPL Plume Containment System: Additional Extraction Wells (Phase II)	11/93
Source Control: Additional Extraction Wells	07/94
APL Plume Containment System	08/94
Final Capping/Site Closure	12/94
First Five-Year Review	09/96
Geophysical Investigation (Site Re-Characterization)	06/01
Second Five-Year Review	09/2001

TABLE 1: CHRONOLOGY OF EVENTS	
NAPL Plume Containment System: Additional Extraction Wells (Phase III)	12/2001
Site Characterization Report: Revised Geologic and Hydrogeologic Characterization	02/2002
Retrofit of Existing Monitoring Wells to Piezometers Screened in 11 Flow zones	12/2002
Site Characterization Report: Hydrologic Characterization	02/2003
Site Characterization Report: Groundwater Flow Model	06/2003
Site Characterization Report: Remedial Characterization Report	06/2003
Superfund Preliminary Close-out Report	07/2903
Major Ions Study	11/2003
Comprehensive Remedial Characterization Report	08/2004
Remedy Determined Operational and Functional by EPA	09/2004
Third Five-Year Review	09/2006
Fourth Five-Year Review	09/2011
Explanation of Significant Differences	05/2012
Deletion from the National Priorities List	10/2013

TABLE 2: LIST OF DOCUMENTS REVIEWED	
Enforcement Decision Document	11/85
Stipulation on Requisite Remedial Technology	5/86
Intermediate and Deep Formations Study	9/90
TCDD Bioaccumulation Study	9/91
First Five-Year Review	9/96
Second Five-Year Review	9/01
Site Characterization Report: Revised Geologic and Hydrogeologic Characterization	02/02
Site Characterization Report: Hydrologic Characterization	02/03
Site Characterization Report: Groundwater Flow Model	06/03
Site Characterization Report: Remedial Characterization Report	06/03
Superfund Preliminary Close-out Report	07/03
Major Ions Study	11/03
Comprehensive Remedial Characterization Report	09/04
Performance Monitoring Plan	07/06
Third Five-Year Review	8/06
Fourth Five-Year Review	9/11
Quarterly Monitoring Reports	2011
Annual Report	2011
Quarterly Monitoring Reports	2012
Annual Report	2012
Quarterly Monitoring Reports	2013
Notice of Deletion, Hyde Park Landfill	9/13
Annual Report	2013
Quarterly Monitoring Reports	2014
Annual Report	2014
Quarterly Monitoring Reports	2015
Annual Report	2015